

## PROCEEDINGS OF LEARNED SOCIETIES.

## ZOOLOGICAL SOCIETY.

June 22, 1847.—Harpur Gamble, Esq., M.D., in the Chair.

## NOTE ON THE SPERMATOOZOA OF THE INDIAN ELEPHANT.

BY GEORGE GULLIVER, F.R.S.

In the testicle of the elephant that died on the 7th of this month in the menagerie of the Society, there was scarcely any semen. The seminal tubes measured from the  $\frac{1}{109}$ th to the  $\frac{1}{85}$ th of an English inch in diameter; they contained a brownish pulpy matter, which, under the microscope, appeared to be composed of a liquid loaded with a multitude of minute, shining, oil-like molecules, either free or aggregated into roundish and shapeless corpuscles. There were also a few objects like altered epithelial corpuscles; but not a single spermatozoon, either free or in a cell, could be discovered.

Within the tube of the epididymis, however, a few distinct spermatozoa were found; and the drawing of them now shown is on a scale of  $\frac{1}{40000}$ th of an inch, the objects being magnified between 700 and 800 times, linear admeasurement.

It will be seen that there is nothing peculiar either in the form or size of these spermatozoa of the elephant. They resemble generally those of numerous other mammalia. For the sake of comparison I exhibit drawings, made on the same scale, of spermatozoa from the *Cervidæ*, *Camelidæ*, *Ursidæ*, *Mustelidæ*, *Soricidæ* and *Sciuridæ*, all of which are noticed more or less in my papers in the Proceedings of the Society, July 26, 1842, April 11, 1843, and February 24, 1846.

The elephant was supposed to be about forty years old.

I may mention, that while engaged in looking for the testicles of the elephant, we exposed two large muscles arising from the pubes, and inserted into the dorsum of the corpora cavernosa penis. Each of these muscles was quite as large as the biceps muscle of the human arm.

The use of these muscles in the elephant, to elevate, retract and suspend his immense penis, is indicated by their attachments. Under the microscope the fibre of these muscles of the penis was found to possess all the characters of common voluntary muscle.

## BRIEF NOTES ON THE HABITS OF NOCTILIO MASTIVUS.

BY P. H. GOSSE, Esq.

The following notes are extracted from a journal kept in Jamaica during a residence there in the years 1845 and 1846:—

“ Being out on a shooting excursion on the 18th of October, 1845, round Crabpond Point, on the southern coast, about the middle of the day I looked about for a seat on which to rest while I ate some refreshment. A gigantic cotton-tree (*Eriodendron anfractuosum*) in the grass-piece of Mount Edgecumbe seemed to promise in its long root-spurs the seat I was seeking. On arriving at it I found the tree was hollow, the trunk forming a wide chimney of unknown

height, as being closed at the top, the darkness prevented my seeing more than a few yards up. I remarked to my servant that it was a likely locality for bats; but the appearance of a large Gecko drew off my attention, and I attempted to capture it. The reptile darted however within the cavity, and I then noticed that beneath the hollow was piled a heap, several feet in diameter, and at least a foot in height, of a soft granular substance, which on examination I found to be the dung of some insectivorous animals, with a very rank peculiar odour. I had now no doubt of the tree being the abode of bats, but had little expectation of being able to ascertain the fact. While peering carefully up, however, I distinctly heard the flapping of wings and some shrill squeakings, and this determined me to fire my fowling-piece at random up the cavity. This I did twice, and though I brought down nothing but a little rotten wood, yet presently, when the smoke had a little subsided, on looking up again I discerned amidst the darkness one or two heads, which seemed those of rats, and immediately another just above them, evidently crawling downwards. I pointed them out to my negro lad, who saw two or three more, and presently, as it became more clear of smoke, the whole sides of the cavity appeared full of curious round faces. I now fired, no longer at random, and had the pleasure of bringing down this beautiful bat, which fell dead. The smoke of this discharge made the others more anxious to come down to the fresh air, and we could see them descending fast, head downwards. As the shot lacerated the membranes considerably, I bethought myself of another plan: cutting a long switch with a few twigs at its extremity, I stood at the bottom and *whipped* one down; he came sprawling with expanded wings on the ground, apparently with but little notion of flight, although unwounded. On being taken up by the wings he displayed uncommon fierceness, biting savagely and powerfully anything within his reach. Three or four more I obtained in the same manner and brought home.

“When thrown up into the air in a room, they would not fly, but merely opened the volar membranes to break their fall, as with a parachute. Two, which I kept alive, hung themselves up by the hind-feet from the side of a cage into which I put them, and would not move, except to shift an inch or two; nor did the approach and arrival of night excite them to activity. One, however, which had contrived to secrete himself in the room, when, having taken both out of the cage, I turned my back for a moment, and which I had vainly searched for, I found at night, by going into the room with a candle: hearing a scrambling, I looked up to the top of the wall, where was my lost bat, endeavouring to suspend himself. On being touched he flew off, but immediately alighted, and so repeatedly; sometimes, when he failed of taking a hold of the wall, he came to the floor, whence he readily rose, though very obliquely. I was struck with his expanse of wing when performing his noiseless flight around the room, and with his resemblance to a bird, aided by the enormous interfemoral membrane, which being expanded by the hind-

legs and *depressed*, looked like the broad tail of a flying bird, and appeared to guide the motion in like manner.

“ While taking some drawings of one, as it hung from the immense hind-feet, I was amused to see how it would thrust its nose into every part of the volar membranes, apparently searching for parasites (of which several were briskly crawling among the hair); and now and then it brought down one hind-foot, and scratched itself with exactly the motion of a monkey; and once I observed, after scratching its breast, it delivered something into its mouth. The flexibility of the ankle-joint was extreme, so that the foot could reach with ease any part of the body.

“ I presented to one a large cockroach, which he seized greedily and munched up, moving the jaws only vertically. The eating was attended with a loud and very harsh *crunching* of the teeth—not produced by crushing the horny parts of the insect, for it was equally perceptible when munching a bit of soft flesh. The jaws moved rapidly, but yet the mastication was a long operation, *for it appeared to me to be performed almost wholly by the canines*. As the insect was progressively masticated, portions were allowed to fall into the cheek-pouches (the one being pretty well filled before the other was used), which when full hung down on each side of the lower jaw, to the depth of three or four lines, like distended bags, displaying a warted surface. When the whole of one cockroach had been masticated, and deposited in the pouches, it would take another, which was gradually disposed of in the same receptacles; then, after a few moments' intermission, by a contortion of the jaw, aided by the motion of the muscles of the pouch, a portion was returned to the mouth, and again masticated. This was repeated till all was swallowed, and the pouches appeared empty and contracted up out of sight. The whole process was much like rumination. Small portions of the muscle of a bird, which were presented to one, he chewed up and deposited in the pouches; but after being regurgitated, and a second time masticated, they were expelled instead of being swallowed. The process of eating seemed an awkward one; it was a rapid succession of choppings with the long canines, through which the tongue was thrust about so nimbly that it appeared a wonder it was not impaled perpetually.

“ In order to rest, like other bats they crawled upwards and backwards by means of the hind-feet, seeking the greatest elevation they could attain which afforded a hold for the claws. They were social, though both were males; usually hanging side by side, or sometimes with the leg of one crossing the leg of the other, or even one upon the other. Sometimes they brought their faces together, and licked each other's open mouths in a singular manner; and this appeared grateful to them. I did not hear either of them click or squeak.

“ Pressed by numerous engagements, I was prevented from again visiting the tree until about ten days after. I then went thither in the afternoon, wishing to see the bats emerge for the night; but though I waited till after sunset, not one appeared. The next morn-

ing I smoked the cavity again, using the fumes of burning nitre and sulphur, but entirely without success. I hence inferred that they had deserted the tree as a dwelling on the first molestation. After some months, however, I again found it tenanted by the same species, if not the same individuals, and succeeded in obtaining another specimen, whose manners in captivity were identical with those recorded above.

"I have never seen the species abroad (so as to identify it), but my intelligent negro lad, Sam, observed two about noon on the 16th of April, the sun shining vertically. It was at a provision-ground at Belmont, where they were clinging to the limb of a young Avoçada Pear (*Persea*). A Banana-bird (*Icterus leucopteryx*) was flying towards them, apparently with the intention of pecking them, on whose approach they flew away in different directions. The lad did not perceive them until the very moment of separation and flight, but he noticed that they were in actual contact, though he could not tell their position. No hole or hollow tree was near. Could they have been *in copuld*?"

I conjecture that it is the present species to which reference is made in the following paragraph, which appeared in the Salisbury Journal of February 6th, 1847:—"Mr. Thomas Dickon, an eminent farmer in Lincolnshire, had been induced to go to Jamaica, as manager of some extensive estates there, with the intention of introducing the best systems of farming where they had been hitherto unknown. Accounts have been received, that there is already every probability of a considerable increase of sugar being produced by applying a new guano as tillage. It is the dung of large bats. The bats are said to amount to myriads; and Mr. D. having observed many of these singular animals entering the crevices of one of the numerous rocks, caused an opening to be made and the place explored. The cave was found to be 250 feet long, 20 feet broad, and from 20 to 30 feet high. The interior contained thousands of these animals, and appeared to have been their dwelling for ages. At the bottom of the cave, bats' dung, at least four feet in thickness, and amounting to about 600 tons in weight, was discovered, and found to be equal to the best Ichaboe guano."

I sent a copy of the above notice to my esteemed friend Richard Hill, Esq., of Spanish Town, who thus replied: "I know Mr. Dickon, to whom your newspaper paragraph relates. He details his experience in the parish of Westmoreland [the same part of Jamaica as that in which my own observations were made.—P.H.G.]; I will however endeavour to ascertain the precise locality in which he had discovered his extraordinary colony of bats. The Council of the Royal Agricultural Society of Jamaica, of which I am a member, had had its attention called to the manure to be obtained from fæcal deposits in caves frequented by bats, and they had analysed the material, but found it so largely charged with the comminuted wing-cases of insects, and so little acted upon by decomposition, that the azotized ingredients combined but slowly as a fertilizer. Several

similar accounts were given to us of cave-deposits, to that furnished by Mr. Dickon. His discovery however being made in an unopened cavern, into which the bats had penetrated through crevices in the rock, has special recommendations to notice.

'My attention was some time ago drawn to a similar harbouring-place of our *Cheiroptera*. One evening, as I was crossing the marshes between Spanish Town and Kingston, by the high-road, I was surprised at sundown at the sudden rushing out of a stream of bats from the face of a cliffy hill that rises precipitously from the swamp. They continued pouring out for some quarter of an hour or twenty minutes; they stretched like a string for some hundred yards, in consequence of the one-by-one file in which they came forth from the crevice, and then dispersed themselves up and down and all about, covering the whole expanse of the contiguous marsh. The long highway perspective across the swamp; the level bed of rushes bending in wavelets to the evening wind; the distant mountains with beetling summits and broken declivities, lighted in angular patches by the setting sun, exhibited a wide, dilated and diversified scene, in which no object rose to interrupt the line made by the flitting swarms as they streamed out from the face of the cliff, and spread their myriad numbers over the plain. I have myself noticed the great depth of the rejectamenta of bats in these caverned recesses, but a great deal of it consisted of *undecayed down*, as well as faecal mutings, and undevoured fragments of insects.'

In a subsequent communication my friend favoured me with a sample of the excremental deposits from a bat-cavern on Swansea estate in the Vale of Luidas; and I forward it, with this paper, to the Zoological Society.

I close this article with a few particulars of description, some of which are better observed on the living animal than on specimens dried or in spirit. A male measured as follows:—“Muzzle to insertion of tail,  $4\frac{1}{10}$  inches; expanse of volar membranes,  $24\frac{3}{4}$ ; ear, from posterior base of tragus to tip,  $1\frac{3}{20}$ ; ditto, from anterior base to tip, 1; tragus, longest side,  $\frac{3}{10}$ ; shortest,  $\frac{3}{20}$ ; nose to front angle of eye,  $\frac{5}{10}$ ; nose to front of tragus,  $\frac{1}{2}\frac{9}{10}$ . Colour varying; upper parts yellow-brown, more or less bright; a well-defined narrow line of pale fulvous runs medially down the back from the head to the tail; under parts pale fawn, bright fulvous or orange; face purplish; the muzzle and chin are much corrugated; face warty; the ears fall into elegant curves. The volar membranes are delicately thin, transparent and glossy; studded with minute, white, papillary glands, which for the most part follow the course of the blood-vessels, but are largest and most numerous in the vicinity of the trunk. The membranes being attached along each side of the spine, with an interval in the middle of the back of but  $\frac{7}{10}$ ths of an inch, the body is, to a great extent, free. The wing, when at rest, has but a single fold, the ultimate joint of the second and third fingers being brought back upon the penultimate. The reproductive organs are large and prominent. At the base of the penis are two follicles, secreting a dark brown sub-

stance, dry and lumpy, but friable between the fingers, most insufferably musky, the odour from which is strongly diffused by the animal during life."

From the width of the gape, the length of the teeth, and the power of the jaws in this species, together with the ferocious eagerness with which my captive specimens snatched at large cockroaches, I conjecture that its insect-prey is large; probably nocturnal beetles and the larger moths and sphinges.

July 13.—William Yarrell, Esq., Vice-President, in the Chair.

The following papers were read:—

OBSERVATIONS ON THE DISTINCTION BETWEEN THE CERVICAL AND DORSAL VERTEBRÆ IN THE CLASS MAMMALIA. BY H. N. TURNER, JUN.

Doubtless it will be remembered that in many Mammalia the last cervical vertebra has a transverse process of simple form, wanting the perforation for the passage of the vertebral artery, so characteristic of the remaining vertebræ in this region of the spine, and which, together with the absence of articulated ribs, has been considered as the definite character by which such a vertebra may be distinguished. However, it is now well known that the existence of this foramen in the transverse process of the seventh cervical vertebra is rather the exception than the rule among the mammalian class, since it is wanting in most of the lower Quadrumana, as the Cebi and Lemurs\*, in nearly all the Carnivora and the Rodentia (except the Hares), in the Ruminantia, and several of the Pachydermata and Edentata; but as its presence or absence has but little importance either in a zoological or physiological point of view, it is needless to enter minutely into that question.

It is perhaps scarcely necessary to add, that in the six upper cervicals this foramen is formed by the existence of two exogenous processes, the diapophysis and parapophysis, and the junction of their extremities through the intervention of a small autogenous element, a pleurapophysis or vertebral rib, which becomes ankylosed to them, in the warm-blooded animals, at an early period of existence. One of the cervical vertebræ of a whale, described by Mr. Gray in a paper

\* As some of the exceptions to this generalization possess some interest, it is perhaps as well to notice them. We need not descend lower than the Chimpanzee to witness the disappearance of the foramen, as in this animal its existence is only indicated by a minute process thrown out from the transverse process, and another from the body of the vertebra, but they do not meet; this would render it most probable that the stylet enclosing the foramen beneath is exogenous. In the skeleton of a half-grown *Cynocephalus leucophæus* in my own collection, the foramen is wanting on one side; on the other it is very small, and the stylet enclosing it shows no trace of separation from the other parts. But the most remarkable peculiarity is that occurring in the Orang-Utan, whose neck is short, and usually hangs forward. In the skeleton of this species presented by Sir Stamford Raffles to the College of Surgeons, not only does the transverse process of the seventh cervical vertebra show no foramen, but even that of the sixth has it very small on one side and quite obliterated on the other. On the other hand, in the *Indri brevicaudatus*, a rather long-necked Lemur, the foramen is very distinct in the seventh.

recently read, affords a very interesting example of the existence of both the processes, but without the little element which would unite their extremities.

In the seventh cervical vertebra the upper transverse process only exists, and the small rib is generally also absent. When the foramen is present in this vertebra, it appears to be enclosed beneath simply by the extension of a little osseous stylet from the under side of the diapophysis to the body of the vertebra, just as the neck of one of the true ribs extends between the points where its head and tubercle are articulated; but whether this stylet be autogenous or exogenous, that is, developed from a separate point of ossification or not, I have at present no means of ascertaining.

I was led to remark on this subject through the accidental discovery in the skeleton of a Polecat (*Mustela putorius*) of a pair of rudimental ribs, or rather portions of ribs, moveably articulated to the extremities of the transverse processes of the seventh cervical vertebra; their length is exactly one-fourth of an inch of true bone, besides a little cartilaginous appendage at the tip. In a second specimen I searched for a similar peculiarity, but was unable to perceive its existence. The two specimens were both males, of mature age and robust dimensions, resembling each other in every particular. This circumstance naturally led me to observe with considerable minuteness the skeleton of the Three-toed Sloth (*Bradypus tridactylus*), in which the existence of nine vertebræ anterior to those forming part of the thorax has long been known; and the discovery by Professor Bell of rudimental ribs articulated to the eighth and ninth of the series renders that exceptional instance additionally interesting. I therefore attentively perused the paper contributed by that learned naturalist to the first volume of the Society's Transactions.

It may indeed appear presumptuous on my part to dissent from the conclusions which so eminent a professor has drawn from his discovery, but my observations led me irresistibly to the conclusion, that if there is any essential distinction between the vertebræ of the cervical and dorsal regions, the eighth and ninth vertebræ of the *Bradypus tridactylus* must be classed among the former.

The skeleton upon which my notes have been made is that contained in the Museum of the Royal College of Surgeons; it must be perfectly mature, although the epiphyses at the distal extremities of the ulna and radius still remain distinct, for every other epiphysis has lost all trace of separation from the bone to which it belongs, and the characteristic ankylosis which unites most of the bones of the foot is completely effected. The sternal ribs are all perfectly ossified; the first four of them are ankylosed to their corresponding vertebral ribs, and the first one also to the manubrium sterni;—so small, comparatively, is the amount of respiratory action required by this slow-moving quadruped.

The differences existing between the eighth and ninth vertebræ and those immediately above them are most clearly and accurately described by Professor Bell; surely it can hardly be necessary here to quote his words; but on comparing either the description that he

has given, or the skeleton itself, with the cervical vertebræ of almost any other mammiferous quadruped, it is most easy to perceive that the *eighth* and *ninth* vertebræ of the Sloth differ from the other cervical vertebræ in precisely the same manner as do the *sixth* and *seventh* vertebræ of other Mammalia from those preceding them in the series. He observes, in describing the *eighth* vertebra, "In the first dorsal each transverse is completely divided into an anterior flattened process, which is turned forwards, and a true lateral or transverse one, which supports the little articulated rib. The transverse process is smaller, but considerably longer, than those of the true cervical, and stands more in a lateral or transverse direction." These characters are precisely the same, excepting that the little articulated rib is wanting, in the *sixth* vertebra of nearly all Mammalia, and in most of them still more distinctly and strikingly manifested. But in the excellent description given by the learned professor, one point at least has been omitted, and that is the existence of the foramen for the vertebral artery in the *eighth* vertebra of the Sloth: no doubt the coexistence of the same foramen in the upper vertebræ will account for its not being mentioned, but its presence tells strongly in favour of the cervical nature of the vertebra.

The transverse process of the *seventh* cervical of the Sloth, also so carefully described by Professor Bell, accords exactly with that of the *fifth* of other Mammalia, in presenting a character intermediate between that which precedes and that which follows it. In speaking of the *ninth* vertebra of the Sloth, he proceeds, "In the second dorsal vertebra the anterior processes do not exist, and the body assumes the form of the succeeding ones. The transverse processes are simple and obtuse, and the articular surface is slightly excavated." I have already pointed out the character presented by the seventh cervical in most Mammalia, which will be seen to agree well with that just cited of the ninth in the Sloth.

In the skeleton examined by myself, the upper pair of rudimental ribs, that is, those attached to the *eighth* vertebra, are wanting—no doubt accidentally lost, and therefore in no way influencing the present argument; but the second pair, attached to the *ninth* vertebra in a manner just similar to that which I have noticed as occurring abnormally in the Polecat, have contracted a complete ankylosis with the extremities of the transverse processes to which they are connected, thus showing, what it seems that Professor Bell's specimen did not exhibit, that this rib is not permanently moveable, but at some period of life becomes a fixture. The figure given by Professor Bell in illustration of his most valuable paper does not show any indication of the existence in the transverse process of the *ninth* vertebra of the foramen for the passage of the vertebral artery; but as this foramen is but small, and the position in which the figure is taken not a very favourable one for exhibiting it, it may nevertheless have existed in his specimen; the minute foramen which he mentions, "for the passage of intercostal vessels," must be one pierced in the rib itself. In the specimen which I examined however, we have the *ninth* vertebra presenting the foramen for the vertebral artery, en-

closed, as I have already shown in the *seventh* of other Mammalia, by a little osseous stylet extending between the under side of the transverse process and the body of the vertebra, imitating the neck of a true rib; and as this is coexisting with the rudiment discovered by Professor Bell, but here ankylosed with the end of the transverse process, it really presents the appearance of the upper portion of a true rib, merely having the neck a little thinner than usual. This circumstance may perhaps seem to weaken my position; but when I consider that this vertebra presents the same general characters as the *seventh* cervical of most Mammalia, where, although the rib be wanting, the foramen is generally wanting also; and also the existence of the rib together with the absence of the foramen in the Polecat, I think the balance of evidence will still be in my favour. And Professor Owen has shown to me, in the College of Surgeons' Museum, a preparation from the human subject, showing a pair of ribs articulated to the *seventh* cervical vertebra by head and tubercle, just as are those of the true dorsal series.

But it yet remains for me to notice one point of resemblance between the *ninth* vertebra of the Sloth and the *seventh* of other Mammalia, which seems to have escaped the scrutiny of Professor Bell: that is, that the body of the vertebra is not rounded beneath, as are those of the true dorsal series, but flat and square; this flatness resulting from the presence of a longitudinal ridge along each side of its under surface, and seeming to represent in a rudimental form the anterior flattened processes of the preceding vertebræ of the series, and whose absence, noticed by Professor Bell in the *ninth* vertebra of the Sloth, is equally characteristic of the *seventh* throughout the rest of the class.

At all events I think I have adduced, from the consideration of the mammalian class alone, proofs of that truth which other departments of Comparative Anatomy have before so well established, that Nature does not rigorously confine herself to those precise rules which we lay down to account for her phenomena; and also, that if we do find it necessary to subdivide the spine into distinct regions for convenience of description, we cannot do so by simply defining characters taken from the peculiarities of a single species, but must compare the characters which the vertebræ present throughout the scale of beings, to ascertain which of them are the most constant and most truly essential in their nature. We may at the same time perceive, that the same artificial subdivision of the spine which answers our convenience so nicely in one class, may be only partially, or not at all, applicable in another; since in Birds there are no lumbar vertebræ, and one vertebra partakes both of the dorsal and sacral character, while in Fishes we find no cervicals, and as ribs are appended to all those of the abdominal series, neither lumbar nor sacral vertebræ can be said to exist.

However, with regard to the distinction between cervical and dorsal vertebræ, as we see them in the class Mammalia, it follows, from the remarks which I have made, that we can define it neither by specifying any particular number as constituting the cervical series, nor